International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 1, Feb 2018, 333-338

MODAL AND HARMONIC ANALYSIS OF A CANTILVER BEAM WITH DIFFERRENT CROSS-SECTIONS

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ABSTRACT

Modal analysis helps to determine the system frequencies and to obtain the eigen modes of various structural members subjected to vibration. In this research, modal analysis and harmonic analysis of a cantilever beam with different sections of same weight and material i.e., rectangle, T-section and I-section are carried out using ANSYS software to see the mode shapes and to observe the dynamic response of the cantilever beam and to identify the best configuration of the beam.

KEYWORDS: Modal Analysis, Mode Shapes, Natural Frequencies, Harmonic Analysis, Dynamic Response & Ansys

Received: Nov 18, 2017; **Accepted:** Dec 08, 2017; **Published:** Jan 05, 2018; **Paper Id.:** IJMPERDFEB201837

Original Article

INTRODUCTION

It is very important to control the resonance in any structure which is subjected to dynamic loads as it leads to failure. Moadal analysis helps the designer to determine the system frequencies and eigen modes which inturn gives idea how the structure will respond to various dynamic loads. Based on the type of response, the response analysis is carried to find the amplitude. in many bridge constructions, some parts are made as cantilever which is subjected to sinusoidal vibrations. Hence in this project it is aimed to study the dynamic response of a cantilever beam under differrent configurations to certify the best one by harmonic analysis using ANSYS.

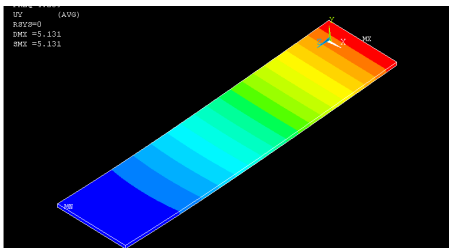
MATERIAL PROPERTIES

Young's Modulus = 2×10^{5} N/mm^{2}

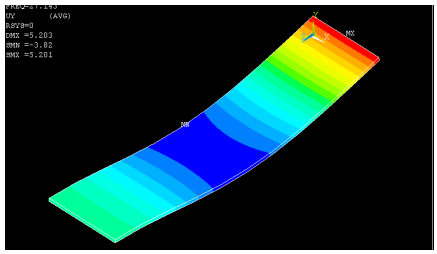
Density of the material = 7.7×10^{-6} kg/mm^{3}

Poisson's Ratio = 0.3

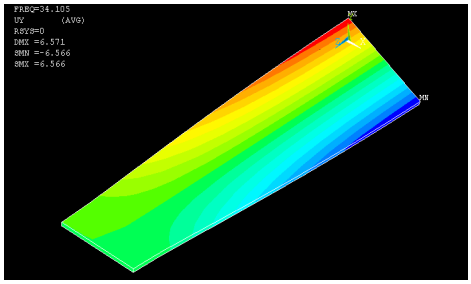
MODAL ANALYSIS OF CANTILEVER BEAM WITH RECTANGULAR SECTION USING ANSYS



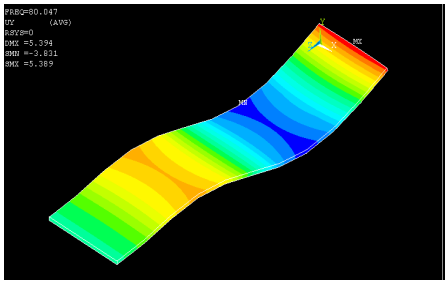
(a) Eigen Mode 1



(b) Eigen Mode 2



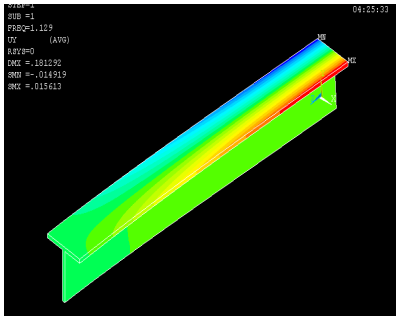
(c) Eigen Mode 3



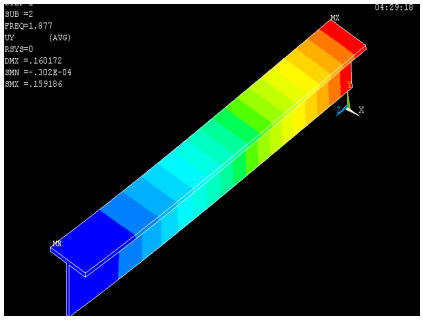
(d) Eigen Mode 4

Figure 1: Eigen Modes of a Cantilever of Beam with Rectangular Section

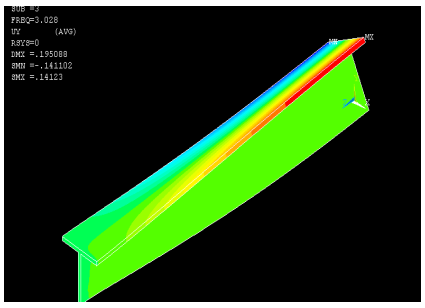
MODAL ANALYSIS OF CANTILEVER BEAM WITH RECTANGULAR T-SECTION USING ANSYS



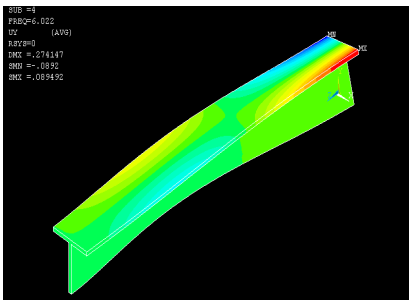
(a) Eigen Mode 1



(b) Eigen Mode 2



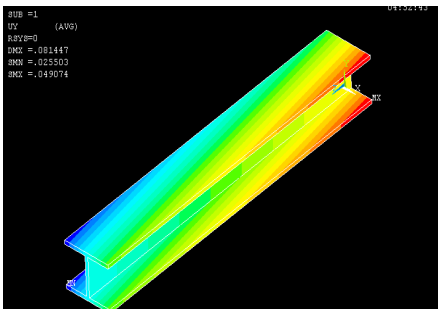
(c) Eigen Mode 3



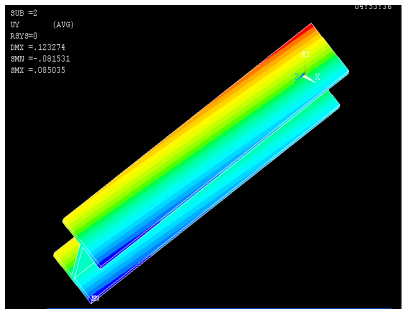
(d) Eigen Mode 4

Figure 2: Eigen Modes of a Cantilever of Beam with T- Section

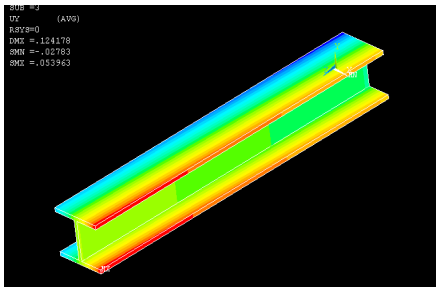
MODAL ANALYSIS OF CANTILEVER BEAM WITH I-SECTION USING ANSYS



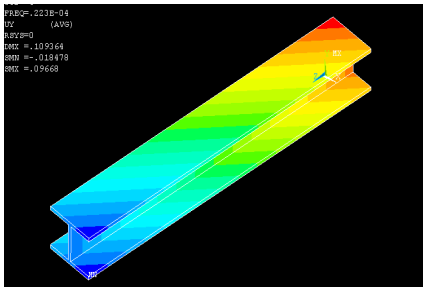
(a) Eigen Mode-1



(b) Eigen Mode 2



(c) Eigen Mode 3



(d) Eigen Mode 4

Figure 3: Mode Shapes of a Cantilever of Beam with I-Section

HARMONIC ANALYSIS OF CANTILEVER BEAM WITH RECTANGULAR SECTION USING ANSYS

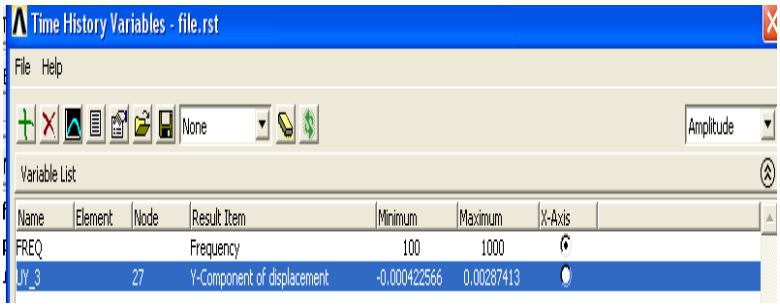
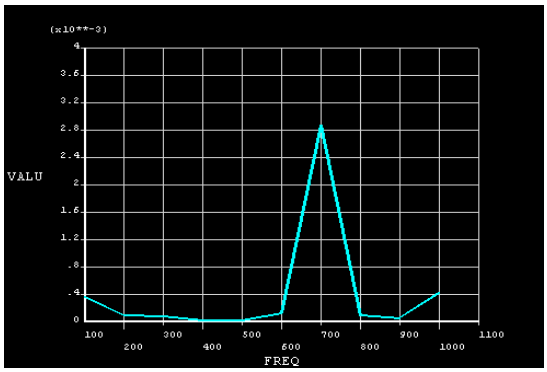


Figure 4: Amplitude of Cantilever Beam of Rectangular Section



Graph 1: Frequency Vs Amplitude of Cantilever Beam of Rectangular Section

HARMONIC ANALYSIS OF CANTILEVER BEAM WITH 'T' SECTION USING ANSYS

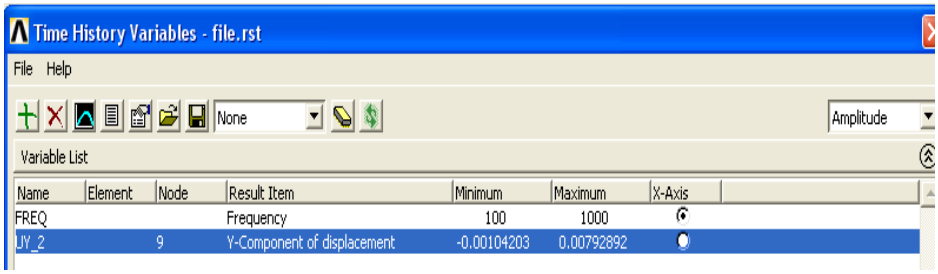
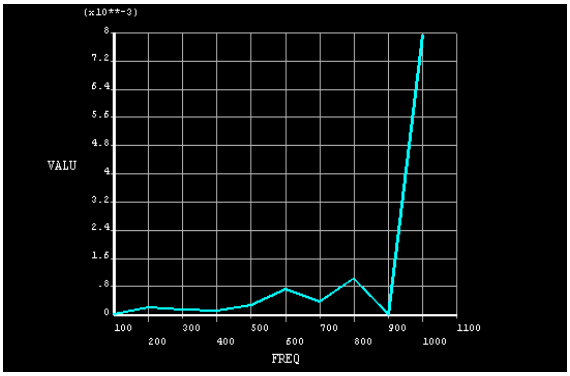


Figure 5: Amplitude of Cantilever Beam of T-Section



Graph 2: Frequency Vs Amplitude of Cantilever Beam of 'T' Section

HARMONIC ANALYSIS OF CANTILEVER BEAM WITH 'I' SECTION USING ANSYS

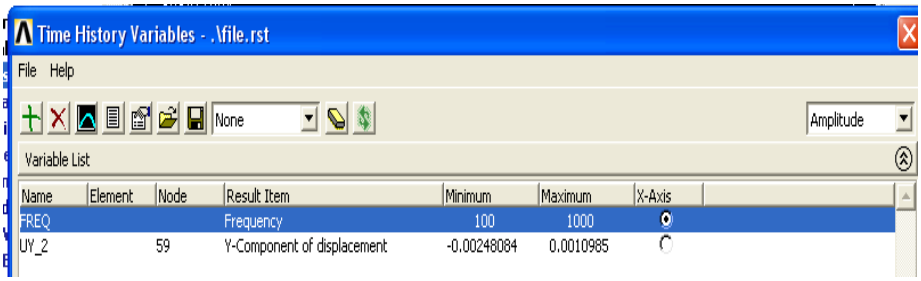
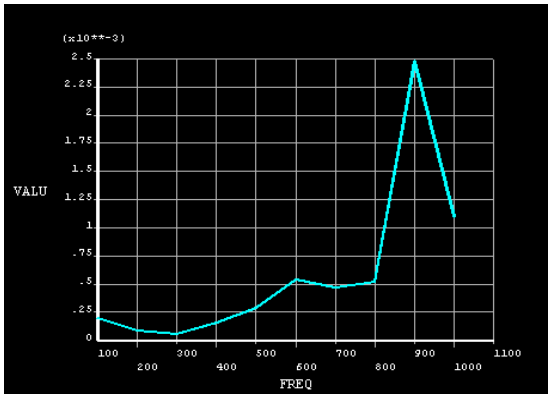


Figure 6: Amplitude of Cantilever Beam of 'I' Section



Graph 3: Frequency Vs Amplitude of Cantilever Beam of 'I' Section

RESULTS & DISCUSSIONS

The mode shapes are illustrated above and the following results were obtained in harmonic analysis of the cantilever beam with different transverse sections.

S. No	Type of Section	Response (Amplitude) in mm
1.	Rectangular	0.0028741
2.	T-Section	0.0079289
3.	I-Section	0.0024808

From the table it is clearly observed that the cantilever beam with I-Cross section has less amplitude when compared to rectangular and T-cross sections and hence it is the best configuration.

CONCLUSIONS

- The Modal analysis of a cantilever beam with different cross sections is carried and mode shapes were obtained.
- The maximum amplitude of cantilever beam with rectangular section is 0.0028741mm.
- The maximum amplitude of cantilever beam with T-Section is 0.0079289mm.
- The maximum amplitude of cantilever beam with I-Section is 0.0024808mm.
- The cantilever beam with I-section is the best configuration when compared to rectangular and T-sections.

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